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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/672,357	09/25/2003	Qiang Fu	42P17274	3046

8791 7590 12/07/2005

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EXAMINER

TRAN, BINH X

ART UNIT PAPER NUMBER

1765

DATE MAILED: 12/07/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/672,357

Applicant(s)

FU ET AL.

Examiner

Binh X. Tran

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 September 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-27 is/are pending in the application.
- 4a) Of the above claim(s) 22-27 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-15 and 17-19 is/are rejected.
- 7) ☒ Claim(s) 16, 20 and 21 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 September 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Group I (claims 1-21) in the reply filed on 9-28-2005 is acknowledged.
2. Claims 22-27 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on 9-28-2005.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1-5, 7, 11 are rejected under 35 U.S.C. 102(e) as being anticipated by Huang et al. (US 6,833,325).

Respect to claim 1, Huang discloses a method comprising the steps of:

forming and patterning a deep UV resist layer (404) on a substrate (col. 8 lines 58-67, Fig 4);

etching the substrate in a plasma generated from a gas C_4F_6 (carbon to fluorine ratio is 4:6 = 2:3) to form substantially vertically sidewalls in the deep UV resist layer (See Fig 4, col. 9 line 64 to col. 10 line 15).

Respect to claim 2, Huang discloses forming a deep UV resist layer and exposing at least a portion of the deep UV resist layer to a light with wavelength of 193 nm or 157 nm (col. 8 lines 60-63; read on applicant's range of "200 m or less").

Respect to claim 3, Huang teaches to form a polymer (412) on the sidewalls of the deep UV resist layer (404) that substantially prevents the deep UV resist layer from being etch (col. 6 lines 10-67, col. 9 lines 47-60). Respect to claim 4, Huang discloses the deep UV resist layer (404) comprises a pre-etch sidewall angle that is substantially the same as a post etch sidewall angle (Fig 4a-4c). Respect to claim 5, Huang discloses etching the substrate in a plasma generated from a gas comprising C_4F_6 and a pressure at 40 mTorr (col. 9 lines 64-67, within applicant's range of 15-100 mtorr).

Respect to claim 7, Huang discloses forming and patterning the deep UV resist layer on a bottom antireflective layer (BARC, read on "sacrificial light absorbing layer) disposed on a dielectric (col. 9 lines 19-24). Respect to claim 11, Huang discloses the sidewall angel is perpendicular (See Fig 4).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Huang in view of Fujimoto et al. (US 6,967,171).

Respect to claim 6, Huang teaches to use power at 3500 watts, 36 sccm C₄F₆, 400 sccm argon (col. 9 lines 64-67; within applicant's range of 1000-4000 Watts, 10-50 sccm C₄F₆, 100-1000 sccm Ar). Huang fails to disclose nitrogen flow rate. In an etching method, Fujimoto teach to use nitrogen gas in combination with argon and fluorocarbon gas (col. 5-6). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Huang in view of Fujimoto by using nitrogen gas because it will enhance the etching process by increasing etch selectivity. Fujimoto further discloses the flow rate is a result effective variable. The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the

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time of invention, to perform routine experiment to obtain optimal flow rate as an expected result.

8. Claims 8-9, 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huang in view of Desphande et al. (US 6,869,542).

Respect to claim 8, Huang disclose the step of etching the light absorbing layer (i.e. antireflective layer) on a dielectric layer (SiO_2) using fluorine carbon gas CF_4 and then etching the underlying dielectric layer using plasma from a C_4F_6 gas (col. 9 lines 25-37). Huang fails to disclose that the carbon to fluorine ratio is from about 1:1 to 2:3 during the step of etching the light absorbing layer. Desphande discloses to etch the anti-reflective layer (ARC) using C_4F_6 or CF_4 . The carbon to fluorine ratio for the C_4F_6 gas equals 2:3. It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Huang in view of Desphande by using C_4F_6 for etching the light absorbing layer because equivalent and substitution of one for the other would produce an expected result.

Respect to claim 9, Huang discloses etching the light absorbing layer (antireflective layer) and then etching the dielectric layer (SiO_2) at a pressure of 40 mtorr and a power of 2500 watts (col. 9 line 64-67).

Respect to claim 17, Huang discloses to pattern the antireflective layer to form a trench. Huang further discloses the trench having a uniform width (See Fig 4). Since the trench having uniform width, the ratio of the bottom width to a top width of the trench must equals to 1:1. The limitation of claim 18 has been discussed above under Desphande's reference.

Respect to claim 19, Huang discloses to use a power at 1200 Watts for etching the antireflective layer (col. 9 line 25-27). Claim 19 differs from Huang by the specific pressure value. Desphande discloses the pressure is a result effective variable range from 20-100 mtorr (col. 12 lines 34-35, within applicant's pressure value). The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention to perform routine experiment to obtain optimal pressure value as an expected result.

9. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Huang in view of Desphande as applied to claim 8 above, and further in view of Fujimoto et al. (US 6,967,171).

Respect to claim 10, Huang teaches to use 36 sccm C₄F₆, 400 sccm argon (col. 9 lines 64-67; within applicant's range of 10-50 sccm C₄F₆, 100-1000 sccm Ar). Huang fails to disclose nitrogen flow rate. In an etching method, Fujimoto teach to use nitrogen gas in combination with argon and fluorocarbon gas (col. 5-6). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Huang and Desphande in view of Fujimoto by using nitrogen gas because it will enhance the etching process by increasing etch selectivity. Fujimoto further discloses the flow rate is a result effective variable. The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been

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obvious to one having ordinary skill in the art, at the time of invention, to perform routine experiment to obtain optimal flow rate as an expected result.

10. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Huang in view of Pfeiffer et al. (US 6,730,454).

Respect to claim 12, Huang fails to disclose the deep UV resist layer comprises an acrylic polymer. However, Huang clearly discloses to use 193 nm deep UV resist layer (col. 8 lines 60-61). Pfeiffer teaches to use 193 nm deep UV resist comprises acrylic polymer (col. 8 lines 45-50). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Huang in view of Pfeiffer by using acrylic polymer for the resist layer because equivalent and substitution of one for the other would produce an expected result.

11. Claims 13-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huang and Desphande in view of Lee et al. (US 6,080,680).

Claim 13 differs from Huang and Desphande by further disclosing that the etch rate of light absorbing layer and dielectric layer is from about 8-120 times faster than the etch rate of the deep UV resist layer (i.e. etch selectivity with respect to resist layer or resist selectivity). However, Huang clearly teaches the resist selectivity is a result effective variable (col. 5 lines 15-23). In an etching method, Lee discloses the photoresist selectivity with respect to the dielectric layer is a result effective variable range from 80:1 to about 200:1 (col. 5 lines 65 to col. 6 line 1, within applicant's range). The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is

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obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to perform routine to obtain optimal selectivity value as an expected result.

The limitation of claim 14 has been discussed above under Desphande reference. Claim 15 differs from Huang by the specific pressure values. Desphande discloses the pressure is a result effective variable range from 20-100 mtorr (col. 12 lines 34-35, within applicant's pressure value). The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention to perform routine experiment to obtain optimal pressure value as an expected result.

Allowable Subject Matter

12. Claims 16, 20-21 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

13. The following is a statement of reasons for the indication of allowable subject matter: The cited prior arts fails to disclose etching the sacrificial layer and dielectric layer at the specific pressure and flow rate C_4F_6 , argon, nitrogen gas as recited in claims 16, 20-21.

Conclusion

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14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Binh X. Tran whose telephone number is (571) 272-1469. The examiner can normally be reached on Monday-Thursday and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Binh Tran

Binh X. Tran